

ANALYSIS OF THE SENSITIVITIES OF THE
North Atlantic Meridional Overturning Circulation

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The adjoint version of the MIT Ocean GCM is used to determine the sensitivity of the maximum in the meridional overturning circulation in the North Atlantic (MOC-MAX) to perturbations in the surface fluxes and the model's subgrid scale parameters. The analysis is carried out in two configurations: one in which the ocean is forced by specified wind stresses and by mixed boundary conditions for the surface heat and moisture fluxes, and a second in which the latter are instead calculated by coupling the OGCM to a one-dimensional (latitudinally varying) heat and moisture balance model of the atmosphere. The results show that the sensitivities can be quite different when the ocean is coupled to the atmosphere. For example, the strong sensitivity of the MOC-MAX to zonal wind stress off the tip of South Africa found in the uncoupled OGCM disappears in the coupled model. Sensitivities to different fields are compared by assuming the perturbations are proportional to the observational uncertainties. In the coupled model the uncertainty in the MOC-MAX arises primarily from the uncertainty in the diapycnal mixing throughout the tropics, and secondarily from the surface moisture flux uncertainty in the tropical Atlantic.